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ABSTRACT

In 1988 SPD1, a division of Motorola, began an extensive 4-year endeavor to transform itself into an organization built on excellence and customer satisfaction. SPD1 contracted with Merex Corporation to provide three services that would enable employees to take on their new responsibilities more effectively. Merex conducted Skills Enhancement Training designed to upgrade employees' basic skills and help them become more effective, self-motivated learners. The program included critical and creative thinking skills. On both objective test measures and subjective indicators, employees showed significant improvements in all skill areas. Merex's Technical Writing System was collaboratively customized to revise SPD1's existing specifications and to set up a system for writing future specifications to the same exacting standards. Using the system, SPD1 specifications were processed according to schedule, were trackable, and remained under strict document control at all times. Merex also conducted Workplace Interaction Training to improve employees' interaction skills and to take advantage of the untapped resource of work force diversity. During 13-week courses, dubbed "Teams R Us" (TRUS), employees learned and practiced communications skills and team-based problem-solving skills. Feedback indicated that employees valued the training, were using the communication skills, and felt that team functioning had improved. (Appendixes include charts with test results, specification project timeline, and TRUS pilot group feedback.) (YLB)

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STRIVING FOR EXCELLENCE

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FINAL REPORT

TO

SPDI MOTOROLA

by Merex Corporation

CE 063 841

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Executive Summary

This report, a collaboration of SPD1 and Merex Corporation, documents an extensive four-year endeavor by SPD1 to transform itself into an organization built on excellence and customer satisfaction.

SPD1 manufactures sensor products for the automotive, consumer and communications markets. To gain a competitive position in this market, SPD1 recognized in 1988 that changes in traditional management practices were necessary. To this end, employees were empowered to improve product quality and customer service. The strategies SPD1 implemented were built on support for Motorola's Quality Policy and are consistent with the strategies of World Class Manufacturing. These strategies include:

- Extensive employee training
- Team participation
- Statistical Process Control
- Just-in-time delivery
- 100% conformance to standards
- Transference of preventative maintenance responsibility to line operators
- Continuous process improvement

In support of these strategies, SPD1 contracted with Merex Corporation to provide three services that would enable employees to take on their new responsibilities more effectively:

1. Skills Enhancement Training. Merex conducted training in reading and math skills designed to upgrade employees' applied basic skills and to help them become more effective, self-motivated learners. The program went beyond reading and math to include problem-solving skills and critical and creative thinking skills. Every direct employee participated in skills upgrade training of some kind, greatly reducing stigma about attending classes. Employees at SPD1 demonstrated a strong appetite for learning once provided the opportunity. On both objective test measures and subjective indicators employees showed significant improvements in all skill areas.

2. Spec Writing and Revision Process. Merex' Technical Writing System was collaboratively customized to revise SPD1's existing technical specifications and to set up a system for writing future specs to the same exacting standards. Using the system, SPD1 specifications are now processed according to schedule, are trackable and remain under strict document control at all times. The revised specifications are uniformly written (standardized), accurate, clear and easily readable by line operators.

3. Workplace Interaction Training. Merex conducted training to improve employees' interaction skills and to take advantage of the untapped resource of workforce diversity. During 13-week courses, dubbed "Teams R Us" within SPD1, employees learned and practiced communication skills and team-based problem-solving skills while grouped in functional work teams. Managers, supervisors and engineers attended as team members alongside line operators. Training was highly interactive and experiential rather than theoretical; real-life workplace situations were used as the basis of exercises and role-plays. Feedback indicated that employees valued the training, were using the communication skills and felt that team functioning had improved as a result of the training.

As a result of these and other efforts, SPD1 has emerged as a vital, competitive organization. Every employee at SPD1 is encouraged to accept responsibility for customer satisfaction. Since 1990, SPD1's initiatives have had favorable impacts on bottom-line figures such as productivity (turns/hr.), conformance to standards, cycle time and P/L ratio. While it is impossible to draw a direct, cause/effect connection between productivity improvements and the efforts described in this report, it is clear that productivity at SPD1 did improve and it is generally agreed that Merex/SPD1 collaborative programs contributed significantly to this improvement.

Project Overview

THE NEED

In 1988, SPD1 (then Small Signal) was in trouble. Productivity was inconsistent, morale was low, employees were not working effectively with each other and the manufacturing process was riddled with problems resulting in high scrap rates and defects.

SPD's workforce included a large number of incumbents with many years' experience in a system that had not encouraged creativity or initiative. Added to this mix were newer employees frustrated by the lack of challenge and opportunity. The organization was a fragmented collection of operations consisting of a wafer fab, test areas, an assembly area, as well as inventory control and maintenance functions. Communication among these areas was poor and employees had little sense of their part in an overall organizational scheme.

SPD1 was also experiencing the same problems facing much of American manufacturing; the increasingly complex demands of the workplace were outpacing employee skills. In the transition from the industrial age to the information age, employees were being asked to switch from manual dexterity to mental dexterity. These changes meant that SPD1 had to reevaluate its workforce, its organization and its manufacturing process.

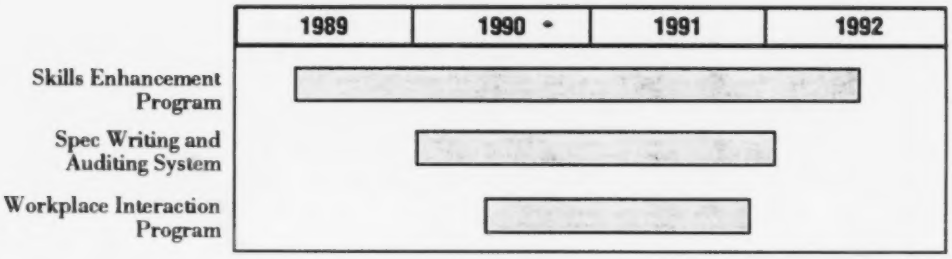
THE VISION

SPD1 management decided to look beyond its short term difficulties to forge an operation built on excellence for the future. This long term vision required employee development, process and materials improvement and a sense of mission and participation within the organization. Quick-fix options were rejected in favor of a process of overall transformation that would emphasize continuous improvement and the Corporate key initiatives of Six Sigma quality, total cycle time reduction, product and manufacturing leadership, profit improvement and participative management.

These lofty goals required some crucial skills in the SPD1 workforce. Employees needed to be able to interact intelligently and efficiently both with process requirements and with each other. Practically, this called for readable process specifications, operators who could implement those specifications and teams that could participate fully in finding ways to improve all aspects of production. Skill-wise, this in turn required a workforce able to read, understand and use workplace materials, and able to communicate effectively within and between teams.

Out of this emerged the three-part Merex program. Basic reading, math, and information-processing skills would be upgraded through the Skills Enhancement Program. A system for creating and maintaining improved technical specifications would be created, and SPD1 employees trained in its use. Team functioning would be enhanced through a team-based Workplace Interaction Training program, focused on actual workplace issues and situations such as workforce diversity and team-based problem-solving.

PROJECT TIMELINE



Skills Enhancement Program

OVERVIEW

To prepare its workers for the future, SPD1 sought the kinds of skills described in the Workforce 2000 report by the Hudson Institute. According to that report, effective workers of the future will have the following characteristics:

- Adaptability
- Decision making and problem solving skills
- Critical and creative thinking skills
- Learning skills

The philosophy and format of Merex training embodies these skills. Merex employs a classroom instructional model with a workplace focus. Using reading and math areas as the content focus, the Merex curriculum embraces the information processing skills required in the emerging global economy. Practice and application of the higher-order skills take place within an interactive group, a format that closely resembles actual workplace requirements.

DESIGN

Assessment and placement

Employees were placed into courses based on a pre-assessment using the Test of Adult Basic Skills (TABE), a national, norm-referenced test that measures basic skills. Post-testing using the TABE also provided measurement of changes over the course of training.

The TABE is a generic test, however, with some limitations in its ability to demonstrate improvements made by adult learners in a work setting. Merex therefore also administered a pre- and post- Work Application Test (WAT) in the reading courses, and a Math Application Test (MAT) in the math courses.

The WAT and MAT were developed by Merex to measure the work-based skills actually taught in the training courses. They measure employees' abilities to use specific skills in a particular setting or a particular way. Test items are based upon Motorola content and application as much as possible, including use of actual Motorola materials. As a result, these two tests are considered the best measures of student progress.

Format and scope of instruction

Reading/information-processing courses were designed in lengths of 300, 90, 60, and 30 instructional hours. Separate 300-hour courses were provided for ESL

(English as a second language) and ABE (adult basic education) employees.

To further increase the impact of the Skills Enhancement Program, SPD1 extended the program to employees who already had strong basic skills. Merex developed a 12 hour course (R12) specifically for these employees. This was a fast-paced course that highlighted key reading and learning strategies, while promoting the message of continuous improvement.

Math courses were designed in lengths of 120, 90, 60, and 30 instructional hours, depending on the need for review and practice in basic math skills.

Most courses met twice weekly for three hours per meeting. Class size was kept small (8-12 employees) to enhance group interaction and to maximize learning.

Materials Integration

During the planning phase and throughout the duration of training, Merex gathered various types of workplace documents to use in the classroom. Specs, policies and procedures, graphs, passdowns, and other workplace documents were used for skill practice in the courses.

IMPLEMENTATION

Instructor training

Instructors were selected who demonstrated exceptional interpersonal skills and who knew how to engage employees in a highly interactive learning process. Instructors were given an intensive orientation to workplace literacy issues, to the Merex program, and to the specific needs of Motorola employees.

Instructors also received ongoing training in the form of regular instructor meetings. At these meetings issues were raised and discussed, further content training was provided, and feedback was given to Merex on how to further improve the skills training.

Orientations

To achieve organizational "buy in", a management/supervisor kick-off presentation was conducted in March, 1989. This was followed by small group meetings with supervisors to discuss and address issues related to the project, especially those expected to be raised by employees. A question and answer flyer was prepared for these meetings, as well as a handout listing how supervisors could encourage support for the program.

Next, employee orientations were held. These meetings served to communicate the need for improved skills, to address anxieties raised by mandatory training and to obtain support for the undertaking.

Assessment and placement

Reading and Math skills were assessed (using the TABE) at the worksite with groups of about twenty-five employees. Sessions took approximately 2 hours and were proctored by Merex staff to enhance confidentially. TABE scores were used to place employees in longer or shorter training courses depending on individual needs.

Feedback

Merex met with employees in small groups to discuss the results of the assessment. Rather than scores, employees were given a general overview of their strengths and weaknesses in reading and math. These sessions also served to discuss training, to clarify expectations and to address questions and concerns about the program.

Individual progress and test results were kept strictly confidential. Merex reported group results to SPD1 management, but employees were assured that classroom performance would not be factored into performance appraisals or promotional opportunities. This confidentiality contributed to the receptive attitude toward the program.

Scheduling

Courses were conducted at the worksite and employees attended on their shifts. Training was mandatory for employees. SPD1 dedicated a classroom for the project, equipping it with materials and supplies necessary for training on all shifts.

Reading courses were conducted during the first half of the project and math courses were conducted during the second half. Scheduling was coordinated with supervisory input to minimize impact on productivity. Figure 1 shows the number of courses taught and the number of employees trained.

COURSE	OFFERINGS	EMPLOYEES
R300	5	40
R90	8	50
R60	13	97
R30	6	31
R12	25	212
M120	3	18
M90	15	120
M60	19	136
M30	3	15
TOTALS	97	719

Figure 1: Courses Taught, Skills Enhancement Program

RESULTS

Employees demonstrated significant gains in all courses as measured by test results. Overall test results are presented below: more detailed, skill-by-skill WAT and MAT results are included in Appendix 1.

TABE Results

Compared with available national research (Keefe and Meyer, 1988), employees in the R300 courses (300 hour reading) demonstrated excellent results. As shown in Figure 2, ABE employees achieved a 2.7 GLE (grade point equivalent) average gain and ESL employees a 2.3 GLE average gain.

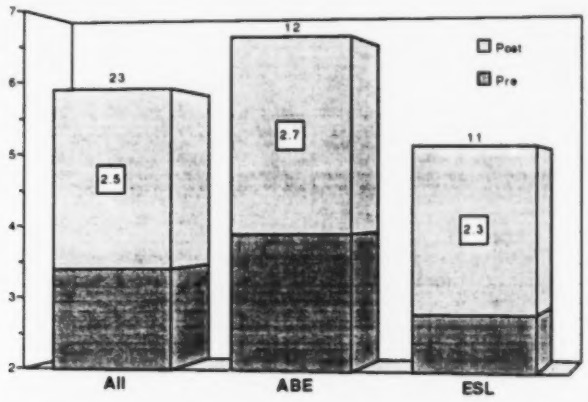


Figure 2: TABE Improvements, R300

Figures 3 and 4 show that, in courses ranging in length from 30 to 120 hours, employee TABE gains were impressive. All of these courses exceeded the nationally accepted standard of 1.0 GLE gain for every 100 hours of instruction (Mikulecky, 1981). In four of the courses, results exceeded 2.0 GLE gains. These results were achieved despite the fact that a significant portion of the Merex classroom time is devoted to the development of other important work skills such as communication, problem solving, and critical thinking—skills not directly measured by the TABE.

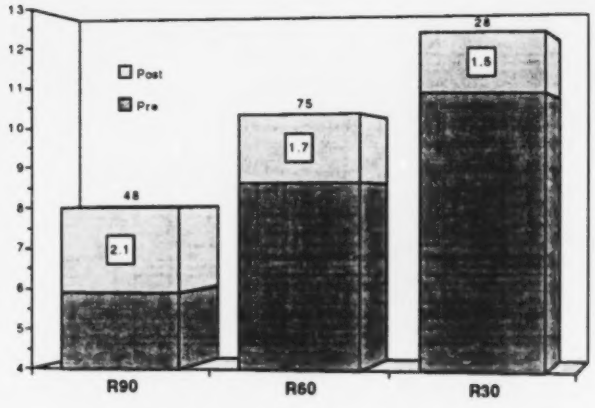


Figure 3: TABE Improvements, R30/60/90

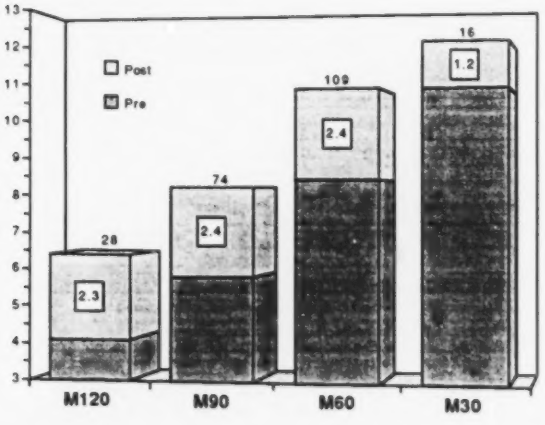


Figure 4: TABE Improvements, All Math Courses

WAT and MAT Results

A special version of the WAT was developed by Merex to assess skill gains in the R300 courses. Figure 5 shows the average pre- and post-WAT scores of employees on skills taught in these courses. Overall WAT scores rose from 18.0% on the pre-test to 71.3% on the post-test. Noteworthy gains were demonstrated in each of the skill categories (see appendix 1 for detailed charts).

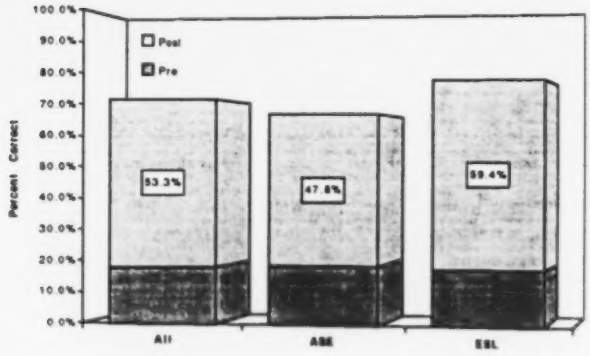


Figure 5: WAT Improvements, R300 Reading Courses

It is noteworthy that ESL and ABE employees showed equivalent gains on the WAT (in fact, ESL employees exceeded the ABE results). This suggests that, on material with a work-based focus, ESL employees are able to compensate for language and vocabulary deficiencies. With both groups of employees, the WAT was a better measure of skill improvement than the TABE. This is consistent with trends indicating that employees will perform higher on work-related materials with which they are familiar than on the kind of general materials reflected in the TABE construction.

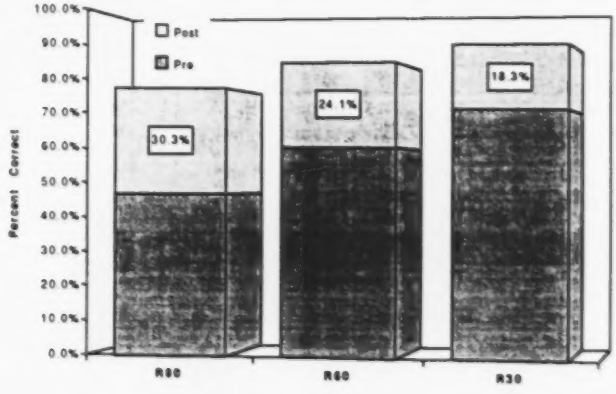


Figure 6: WAT Improvements, All Reading Courses

Figure 6 indicates that students in all reading courses demonstrated significant skill gains as measured by the WAT. In math courses, even more impressive gains were demonstrated by students. These MAT results are demonstrated in figure 7.

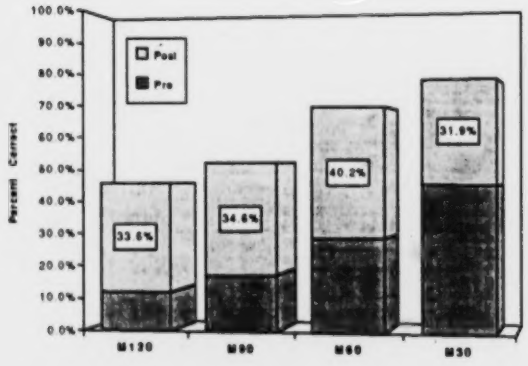


Figure 7: MAT Improvements, All Math Courses

BEHAVIOR CHANGES

The impact of skills enhancement training was also reflected in employee behavior changes as observed by instructors, supervisors and managers. Some behaviors observed by Merex instructors reported by students included:

- Heightened enthusiasm and interest in learning
- Greater self-confidence in interacting with supervisors
- Increased understanding of wafer fabrication
- Interest in the "big picture" at Motorola
- Increased ability to self-monitor level of understanding and learning

The skills enhancement program also aimed for skill transfer from the classroom to the work area. Anecdotal feedback from managers and supervisors provides evidence of skill transfer.

- " _____ asks for help rather than turning around and making the same mistake again."
- " _____ asks more questions and participates more actively since taking classes."
- "My employees are very eager to attend class, they look forward to it and seem to be getting a lot out of the program."
- "Employees express pride in the accomplishments they are achieving in the classroom."
- "Students are now more willing to report and describe misprocessing mistakes so their team can avoid making the same mistakes."

Spec Writing and Spec Auditing System

Overview

The Merex Technical Writing System was collaboratively customized to revise current technical specifications at SPD1 and to set up a system for writing, tracking and controlling future specs. Goals were to make sure that the specifications helped SPD1:

- Meet customer needs and demands
- Reduce product non-conformance
- Improve product reliability

The Merex Technical Writing System is a research-based and field-tested methodology for writing and editing procedural documentation. The system is probably best understood as a document 'manufacturing' system. Using the system, documents are processed according to schedule, are trackable and remain under strict document control at all times. In terms of content and style, the revised specifications are uniformly written (standardized), accurate, clear and readable by the line operators who have to use them.

Effective documentation has been found to enhance process control, flexibility, consistency and speed – all requirements for World Class Manufacturing.

DESIGN

Products

The following products and services were delivered and installed at SPD1 in order to implement the project:

- Microsoft Word templates
- Document specification standards
- Implementation model
- Training modules
- Manuals
- Document control plan
- Project management database

System

SPD1 and Merex worked collaboratively to integrate the Merex Technical Writing System into the day-to-day operations of SPD1. SPD1 was in the process of developing a powerful model for reviewing and validating documentation. This

concept, coupled with the Merex system resulted in the SPD1 Production Model illustrated below. This model is based on the belief that technical documentation is the communication link between two expert systems—engineering and the end user. Therefore, the most accurate and usable specs are those written and validated by a team composed of representatives from both groups.

To ensure that the specs were written in conformance with the Merex writing style, SPD1 spec reviewers and editors were trained in spec editing. Once the spec was edited and reformatted, an SPD1 team was organized to review the content of the spec. The team corrects any omissions, errors or problems with structure. It also validated the language of the instructions. The final review involved "certification" of the spec in the production area.

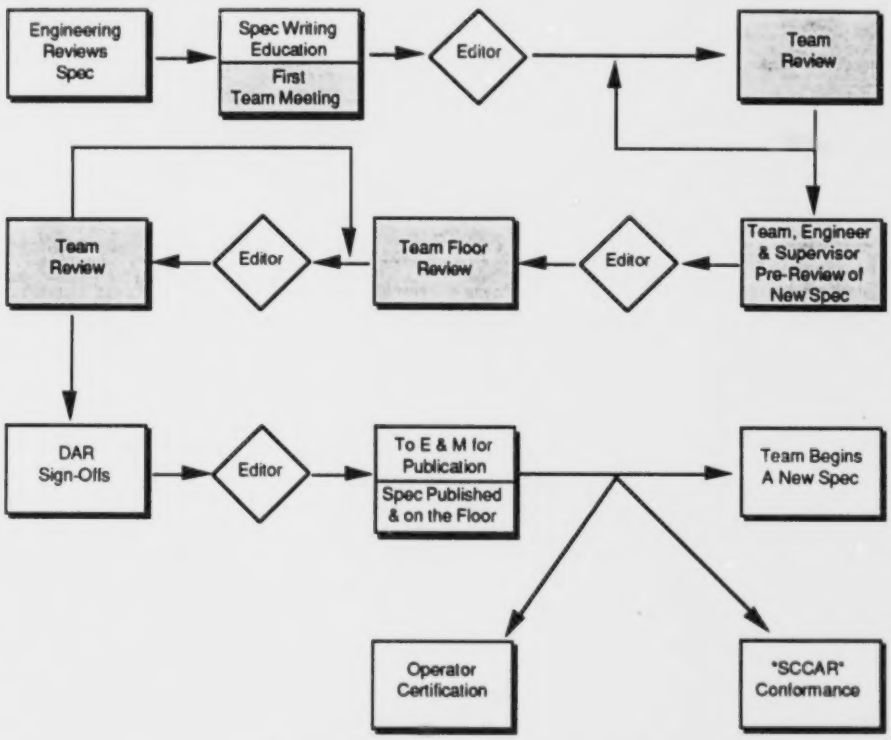


Figure 7: SPD1 Production Model

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The system of integrated Operator Team and Cross Functional Team meetings and reviews, represented by the shaded areas in the production model on the previous page, adds value to the system because it:

- Communicates an organizational commitment to quality
- Defines the quality requirements
- Promotes conformance to standards
- Promotes teamwork
- Involves line operators in continuous process improvement

IMPLEMENTATION

An integrated approach of orientations and training programs helped ensure the successful implementation of the SPD1 Production Model. Meetings were held with each group to explain and introduce the project goals and expectations. The model required that spec users and writers share responsibility for reviewing and correcting specs.

Prototype Specifications

Merex processed several specifications using the Merex Technical Writing System to demonstrate the system. None of these specs were ever posted. The process was used to analyze the current document control system and the special needs and requirements of SPD1. Several problems surfaced during this phase, including the reliability of the information in the specs. In order to ensure the accuracy of the documents, SPD1 implemented an operator peer auditing system.

Manager/Supervisor Orientation

Special orientation sessions were provided to define and explain the role of managers and supervisors in the spec project. The orientation also included a discussion of staffing, time and resource commitments, schedules, deliverables and anticipated results.

Specification Inventory

Merex and SPD1 worked together to generate a prioritized spec inventory. SPD1 personnel later entered this inventory into a project database. The intent was to use this information as the basis for developing a production schedule.

Specification Editing Training

Classes were scheduled to accommodate, whenever possible, the work schedules of participants. The participants were trained in the skills required to successfully translate existing documentation using the Merex Technical Writing System. The training was conducted on-line using a MicroSoft Word template developed by Merex.

By the conclusion of the training, participating editors had begun work on actual specs. The success of the training is illustrated by the fact that the SPD1 editors quickly emerged as the in-house experts on the Merex Writing System and later assisted in technology transfer to other Motorola groups.

Graphics Integration

Editors and Document Control personnel were trained to create original graphics as well as to integrate existing graphics and text into paper documents. This training was conducted on-line using MacDraw software. SPD1 personnel later adopted Canvas as an alternate graphics package.

RESULTS

The involvement of teams in the review and validation of the specs resulted in specs that were understood, accurate, and used by the operators. The increased responsibility and recognition fostered a sense of ownership that in turn resulted in a greater awareness and interest in specs.

By the conclusion of the contract, SPD1 and other groups on site, had formed a users group that took ownership of the spec project. This users group continues to make significant progress in spec editing and validation. They have also refined and customized the system to meet the changing needs and requirements of the manufacturing efforts they support. Their initiative and success have resulted in them becoming the benchmark for other Motorola groups in the area.

The following tables (Figure B) summarize the progress of the ongoing spec revision project through the third quarter of 1992.

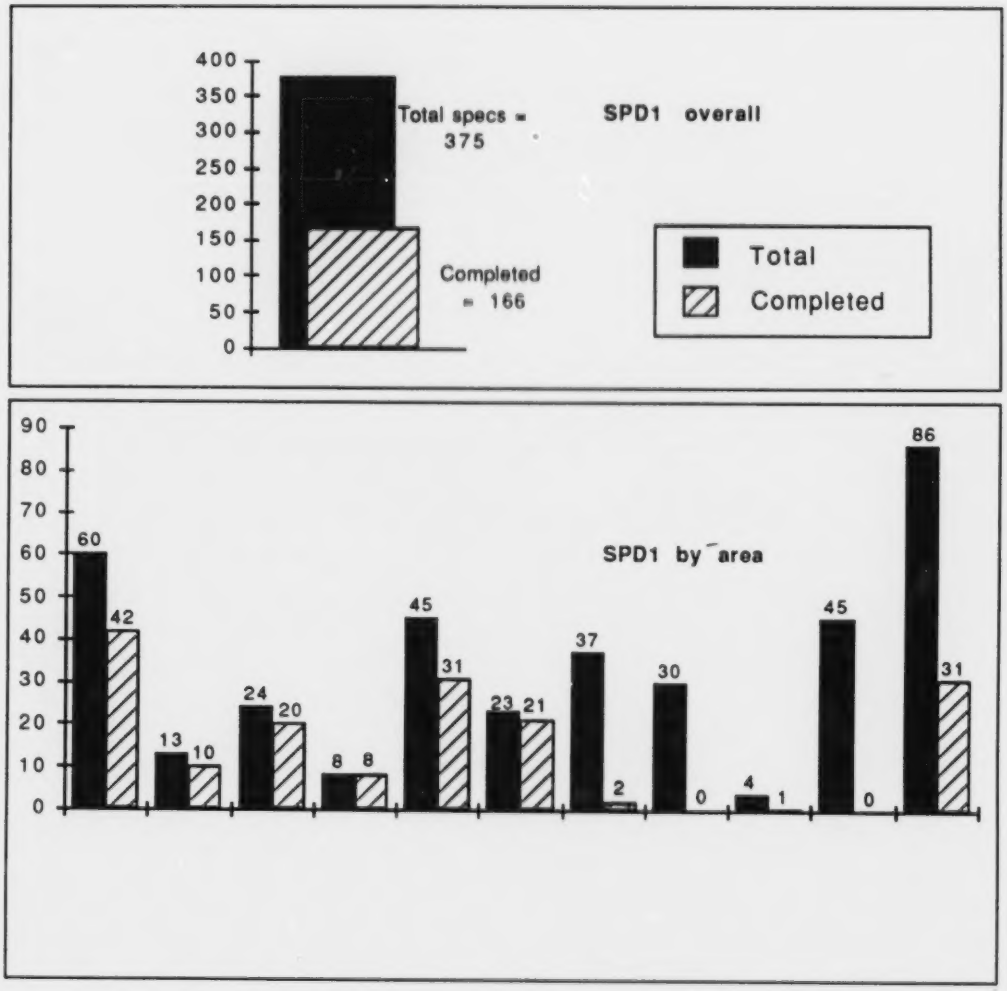

Figure 8: Spec Project Status (Q1 1990 - Q3 1992)

Workplace Interaction Program

OVERVIEW

SPD1, like many forward-looking organizations, has recognized the need for employees to take on new responsibilities at the team level. This requires more than simple delegation of tasks – employees also must be given training in the underlying skills that make effective team functioning possible.

Merex' Workplace Interaction Program was customized to address goals stated by SPD1 management:

- That members of work teams have equality of influence in defining and achieving goals (total team participation);
- That team members take ownership of team performance;
- That effective communication help transform the diversity of the SPD1 work force from a barrier into a resource;
- That, as a result of the above changes, improved team functioning help improve efficiency and profitability.

DESIGN

Format

Merex and SPD1 designed the training to improve SPD1 employees' interactive skills in the context of team-based, workplace problem-solving situations. Training was designed to be skill-based rather than concept-based: employees would learn and then practice skills over an extended period of time. (This is contrasted to programs in which employees are exposed to many concepts and skills in a short period of time, then expected to internalize and integrate those skills on their own after the training.)

The training was scheduled to include, whenever possible, intact functional work teams. Supervisors, engineers, and operators who actually worked together on the floor learned and practiced the interaction skills together.

Scope of training

The skills covered included:

1. Building personal awareness and responsibility. Participants were helped to identify ways that distorted thinking, unchecked assumptions, feelings and values differences can affect communication in the workplace.
2. Effective communication skills. Participants learned and practiced basic assertive communication skills.

3. Applications to the workplace. Participants practiced using communication strategies to resolve conflicts and manage difficult workplace situations.

4. Team-building strategies. Participants explored the impact of group dynamics and roles within their work teams, practiced team-based problem-solving strategies and committed to specific behavioral changes within their teams.

IMPLEMENTATION

Facilitator training

Merex hired facilitators with counseling and group-training backgrounds. They received a 4-hour orientation to the Teams-R-Us program design, followed by weekly meetings with Project Managers throughout the training cycles. These meetings served multiple purposes: to review completed classes; strategize and plan for upcoming classes; and ensure continuous improvement of the Teams-R-Us product.

Pilot group

Merex piloted the training with SPD1 Management representatives and two work teams. Feedback from the pilot group (see appendix III), gathered after every session and at the conclusion of training, helped SPD1 and Merex fine-tune the program prior to full-scale implementation.

Full training project

A total of 34 SPD1 work teams completed "Teams-R-Us" training over the course of 14 months. Class size typically ranged from 15-20 employees, consisting of 2-3 teams. Participants attended a one-hour orientation followed by thirteen weekly two-hour sessions.

Sessions were highly interactive, with discussions, exercises and role-plays predominating. Each session introduced and practiced a new skill and reviewed previous skills. Skills were introduced through activities, practiced in pairs or small groups and then discussed in the large group. Applications to workplace and personal situations were discussed and role-played. Participants were given assignments for practice between sessions, and shared success stories and challenges.

Over the course of the project, participants played an important role in generating examples of current workplace problems and situations on which to try out the skills. A number of issues were actually addressed and resolved during training sessions; others were identified and targeted for future resolution.

Management/Supervisor focus groups

Upon completion of the Teams-R-Us training, two 3-hour focus groups were held with SPD1 Managers and SPD1 Supervisors for two purposes: to review the

impact of the Teams-R-Us training and to discuss "future directions" for SPD1. Managers and supervisors attended separate focus groups, to allow for discussion of issues specific to each group.

Issues discussed included:

- The need for management to back up empowerment commitment with specific behaviors: specifically, to model use of the communication skills and to support supervisors and operators when they use the skills.
- The need for supervisors to define and practice leadership behaviors, and to assume training responsibilities (teaching vs. telling what to do).
- The need to define "self-directed" team responsibilities more clearly.
- The continuing need to communicate the "bigger picture" of Motorola's plans for the future, and how this training and team empowerment fit into that picture.
- The need for follow-up training in specific areas (e.g. running meetings, giving reviews) to build on the skills taught in the current training.

RESULTS

"Teams-R-Us" training focused on individual skill building and the application of those skills into the context of intact teams. As a result, the concepts and skills taught had a greater likelihood of being integrated into the everyday work culture of SPD1.

Participant Quotes

The following quotes taken from "Teams-R-Us" participants reflect the impact of the training.

1. "A 2nd shift person came in upset ready for a fight - approached me, started yelling about what happened. I didn't get hooked and helped to diffuse her anger. It really felt good to not come out feeling bad about the confrontation."
2. "It was really neat for us as a team and me as a person to see that it is OK to feel differently and it's ok to express our feelings with each other."
3. "It is OK to express yourself, be different, and the use of I messages."
4. "Learning to speak up."
5. "Expressing myself more to my co-workers and being able to understand more about differences in people."
6. "Once I got into an argument at work and instead of continuing, I just walked away and came back to the person later when I could rationalize more clearly and talk it out."
7. "Problem solving - when we have a problem we always get together as a team and solve it."

8. "Success is working with the team and having them realize that people think different and that's OK! Having the team be more open to others' ideas and being more considerate towards others and the way they are."
9. "Knowing and learning the tools to handle conflicts.
10. "It gave me so many more skills to use in communicating and getting along with team members. Active listening and I-messages are my best tools."

Project Impact

A project of this scope and magnitude must ultimately be evaluated and justified in terms of its impact on the company.

A number of productivity figures and financial measures have increased dramatically since the beginning of the SPD1/Merex collaboration. While it is difficult to establish a cause/effect connection between these types of macro improvements and any single cause, it is generally agreed that Merex programs contributed significantly to SPD1's improved performance capability.

Some of these gains, as reported by SPD1's "Next Generation" team during the 1991 TCS competition, include the following (current at that time):

- Profit/loss favorable impact of $1,200,000
- 15% increase in turns per hour
- Zero discrepancies in SPC Housekeeping Calibration Specification
- Controllable manufacturing costs at 87%
- Non-conformance decreased by 87%

Issues and Recommendations

A number of issues arise in providing the type of training and services documented in this report. Below are some issues that organizations might consider for future planning.

BASIC SKILLS TRAINING

Employee resistance. Employees may feel anxious about their skill deficits and threatened by a program in which those deficits will be addressed. Communications about the program must be handled sensitively to minimize this anxiety. Instructors must be thoroughly trained to handle any resulting resistance in the classroom.

Customization and relevancy. Training should be skill-based and incorporate actual workplace materials and applications. Instructors should be carefully trained in helping employees apply skills to their own workplace environments and requirements.

Scheduling. Changing production demands may result in the need to change the schedule of training classes after a project is underway. Flexibility in scheduling is a must.

Scope of skills. The workplace of the future demands more than basic reading and math skills. Problem-solving skills, communication skills, and the ability to think critically and creatively are the higher-order skills now demanded of employees. Incorporating them into basic skills training ensures a well-rounded training experience. Employers should consider ongoing training in all these areas.

Evaluation of the program. Ongoing evaluation of the impact of basic skills training is essential, and should not be limited to test results. Systematic feedback from participants and from their supervisors and managers about the perceived quality of the training, its relevance and its impact on work performance are also valuable.

SPEC WRITING & REVISION SYSTEM

Standardization. Strict guidelines for text, graphics and layout help both writers and users of specs function more efficiently.

Input from users. Input from users as well as writers is important in designing specs. User input is valuable both for its own sake and for making employees feel that their concerns and needs are being addressed.

System for writing future specs. A system for ensuring that future specs meet the new standards is a must. Standards and constraints should be built into the system.

System for future maintenance. Maintenance of specs is at least as important as initial writing. A maintenance system should include provisions for tracking and cross-referencing revisions.

WORKPLACE INTERACTION TRAINING

Resistance. Training that encourages and empowers employees to communicate more effectively and assume new responsibilities at a team level is necessarily going to stir up resistance. Both individual employees and the entire organization may struggle with the change and shifting power relationships. Goals for the training, as well as its role in the larger picture of organizational change, must be clearly defined and communicated to all.

Facilitator training. Facilitators must be chosen for their ability to work effectively with groups around difficult issues and then be provided ongoing training of their own to maximize their skills.

Customization. Generic communication skills training will have some impact on any organization. Customized training that incorporates real-life workplace issues, and is targeted to goals articulated by management and employees, is more likely to produce the kind of changes a given organization needs for its particular vision.

Supervisor training. In order to prepare supervisors for the shifting of roles and responsibilities associated with this type of training, special sessions with supervisors both prior to and during the training is recommended.

Comprehensive evaluation. In order to capture the performance and economic impact of the training, it is critical to plan for and implement an evaluation component. Evaluation should include both ongoing feedback (during the training), and summary and follow-up components.

Conclusion

Since 1988, SPD1 has translated its vision into reality. Employee skills were addressed in the Skills Enhancement Program, in which over 6,400 hours of training were conducted. Teamwork and diversity issues within SPD1 were addressed by providing interaction training for intact work teams to learn the skills which underlie effective work relationships. The manufacturing process itself was impacted by establishing a system in which the writing and and review of technical specifications include the operators who must use them.

Evidence of change exists everywhere in SPD1. The Skills Enhancement Program laid the foundation for SPD1's employee development plan (Manufacturing Development Matrix Program). In 1988, there was no employee development plan. Now, all employees understand that continuous educational development is valuable and necessary. The promotional process is clearly linked to educational requirements for each grade level.

By collaborating with a single vendor to provide all three services, SPD1 gained the further value of synergy. As a result of Merex training and services, the SPD1 workforce acquired a common language. Concepts learned in the skills enhancement program were expanded upon and reinforced in interaction training. Communication skills learned in interaction training were applied to effective management of workplace diversity. And, finally, the format and writing style used in producing accurate technical specifications reflected and reinforced information processing skills taught in the skills enhancement courses.

Significant numbers of SPD1 employees have demonstrated their increased appetite for learning by pursuing their GED's, by enrolling in college courses, and by taking advantage of training offered within Motorola. The overall level of employee participation has increased since 1988, some of which is clearly related to the increased self confidence that comes from skill mastery.

Employee empowerment has become more than a catch phrase at SPD1. Employees now conduct their own communication meetings, submit more ideas for performance improvement and problem-solve more effectively within their own work groups.

In 1988, SPD1 specs were inadequate for holding employees accountable to standards. Now that they are accurate and consistent, SPD1 specs have been approved by Sector for certification testing. The SPD1 training department now uses the specs in employee training programs, and formats all its own training materials using the spec writing system. Other organizations now benchmark SPD1's spec writing and review process.

The current SPD1 slogan says it all: "We are winners". As winners, SPD1 employees now define a vision in which they satisfy customers, perform perfectly, and defeat competitors. This vision is possible because of a vision of excellence laid in 1988. Merex has been proud to play a part in this success story.

Appendix 1:

Test result breakdowns,
Skills Enhancement Program

SKILL	ALL N=30		ESL N=16		ABE N=14	
	Pre	Post	Pre	Post	Pre	Post
Survey	42.6%	85.3%	37.5%	88.8%	47.9%	82.1%
Levels of rdg	52.3%	80.0%	36.9%	75.0%	70.0%	84.3%
Patterns	7.0%	65.7%	6.9%	71.3%	7.9%	60.0%
Context clues	23.3%	62.3%	12.5%	65.6%	35.7%	58.6%
Word Parts	4.7%	55.7%	2.5%	67.5%	7.9%	42.1%
Overall	18.0%	71.3%	17.5%	76.9%	18.6%	66.4%

figure 1 WAT IMPROVEMENTS - R300 COURSES, by skill

SKILL	R90 N=29		R60 N=78		R30 N=31	
	Pre	Post	Pre	Post	Pre	Post
Survey	66.9%	86.6%	76.5%	92.1%	81.0%	94.2%
Levels	65.1%	74.8%	70.5%	72.7%	71.0%	80.0%
Topic Sentences	25.5%	59.7%	45.8%	67.3%	54.2%	71.9%
Patterns	16.2%	73.4%	34.4%	86.8%	53.5%	92.9%
Context	55.2%	77.2%	73.2%	86.9%	81.6%	93.5%
Word Parts	31.4%	77.2%	45.1%	87.1%	70.0%	90.6%
Overall	46.8%	77.1%	60.1%	84.2%	70.8%	89.1%

figure 2 WAT IMPROVEMENTS - R-30/60/90 COURSES, by skill

Appendix 1: (cont.)

SKILL	M120 N=14		M90 N=100		M60 N=125		M30 N=14	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Whole Numbers	44.6%	74.1%	61.5%	82.1%	80.1%	90.9%	88.4%	93.8%
Fractions	7.1%	40.2%	16.7%	59.5%	35.3%	80.5%	55.4%	82.1%
Decimals	19.6%	52.7%	28.7%	61.5%	45.9%	78.3%	62.5%	77.7%
Percents	3.6%	33.0%	11.9%	39.9%	23.3%	59.2%	41.1%	72.3%
Signed Numbers	20.5%	45.5%	18.4%	50.7%	32.1%	70.3%	54.5%	76.8%
Order of Ops	6.3%	47.3%	4.5%	46.7%	11.8%	63.4%	32.1%	83.9%
Inequalities	3.6%	41.1%	12.2%	51.8%	16.5 %	59.0%	21.4%	62.5%
Exponents	11.6%	61.6%	11.8%	52.1%	25.5 %	71.6%	53.6%	80.4%
Metric System	2.7%	33.0%	4.0%	46.5%	6.3 %	62.0 %	14.3%	67.9%
Algebra	6.3%	37.5%	10.6%	38.8%	20.5 %	59.7 %	39.3%	76.8%
Formulas	1.8%	26.8%	2.3%	30.1%	7.0%	50.4%	21.4%	69.6%
Overall	12.1%	45.7%	17.3%	51.9%	28.6%	68.8%	45.1%	77.0%

Figure 3 MAT IMPROVEMENTS - ALL MATH COURSES, by skill

Appendix 2:

Spec Project Timeline

	1990				1991				1992			
	1	2	3	4	1	2	3	4	1	2	3	4
Project Coordinator Training												
Management/Supervisor Kick-Off Presentation												
Prototypes Developed												
Task/Step Analysis Process Developed												
Initial Implementation Plan Identified												
Implementation model revised												
Hardware and Software Needs Identified												
Document Inventory Identified and Prioritized												
Templates Installed & Revised												
Training provided to Operator Teams												
Editor Training												
Team Facilitator Training												
Production												
Extensions to the system developed by SPD1												
Operator and Cross Functional Teams Developed												
Self Audit System Implemented												
QA Customer Audit Implemented												
Customer Tours and Presentations												
Certification Program Implemented												
SCCAR Conformance Program Implemented												

Figure 1 spec writing project timeline

Appendix 3:

TRUS PILOT GROUP FEEDBACK

All of this is helping me see myself at Motorola differently.

[This training is] perfect for the transition happening at Motorola.

We are acting and interacting more as a team rather than as individuals.

We are using these behaviors in our meetings.

The examples that were used are real problems and situations we have in the area.

We have become aware of how much our efforts can help the total team.

Gives the team more confidence in expressing their problems without being fearful.

Great effect, not only in dealing with conflicts but recognizing them before they get to that level.

We don't let problems get out of hand like they have in the past.

My attitude has totally changed since these classes began. I feel better with having to deal with people.

The team is more positive and interacts with each other more.

More of our quiet members are beginning to open up.

Another employee came in upset...started yelling about what happened. I didn't get hooked, and helped to diffuse her anger. It really felt good to not come out feeling bad about the confrontation.

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